US009122188B2

(12) **United States Patent**
Fukushi

(10) **Patent No.: US 9,122,188 B2**
(45) **Date of Patent: Sep. 1, 2015**

(54) **IMAGE FORMING APPARATUS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 209 days.

(21) Appl. No.: **13/042,860**

(22) Filed: **Mar. 8, 2011**

(65) **Prior Publication Data**

US 2011/0243586 A1 Oct. 6, 2011

(30) **Foreign Application Priority Data**

Mar. 31, 2010 (JP) 2010-081587

(51) **Int. Cl.**
G03G 15/02 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/0291*** (2013.01); *G03G 2215/026* (2013.01); *G03G 2215/027* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/0291; G03G 2215/026–2215/028
USPC 399/38, 50, 98, 170, 172, 100
See application file for complete search history.

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(57) **ABSTRACT**

An image forming apparatus including: a photosensitive member driving unit configured to rotate the photosensitive member; a charge unit having an opening portion and configured to charge the surface of the photosensitive member; a shield member movable between a closed position for closing the opening portion and an open position for opening the opening portion; a shield member driving unit configured to move the shield member between the closed position and the open position; and a control unit configured to control the photosensitive member driving unit to rotate the photosensitive member in a state in which the shield member is situated at the open position, and to prevent the photosensitive member from rotating in a state in which the shield member is situated at the closed position.

8 Claims, 12 Drawing Sheets

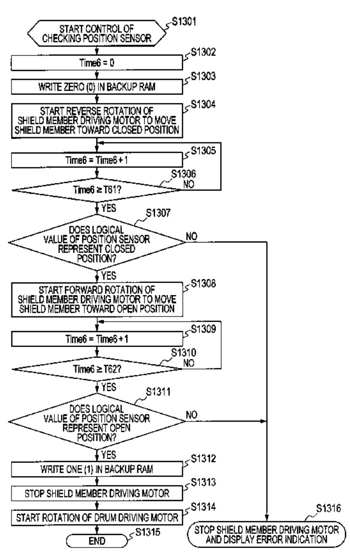

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FIG. 1

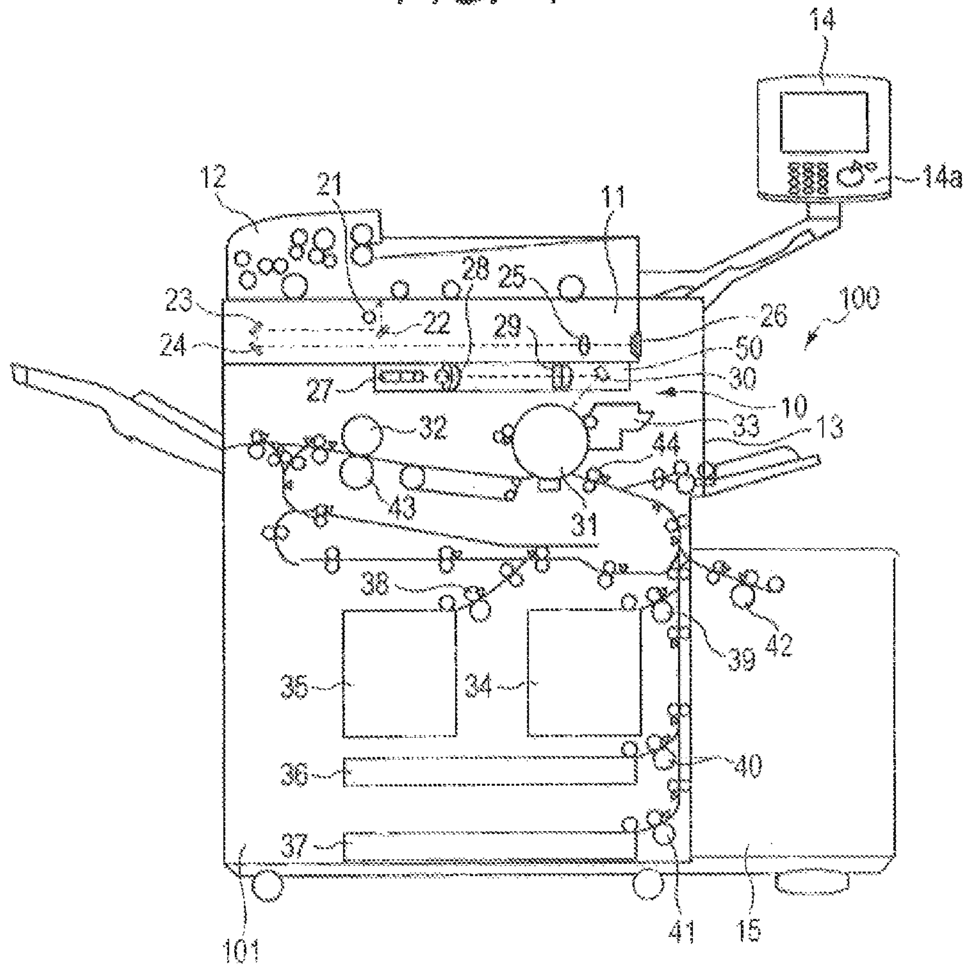
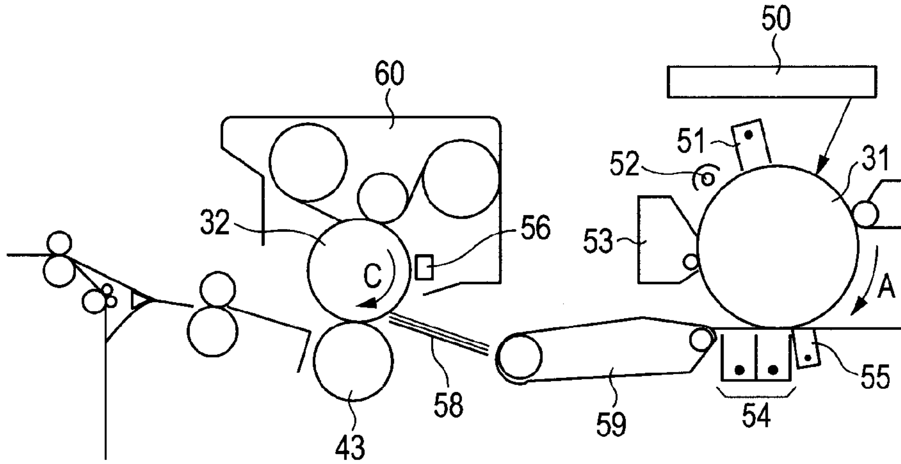
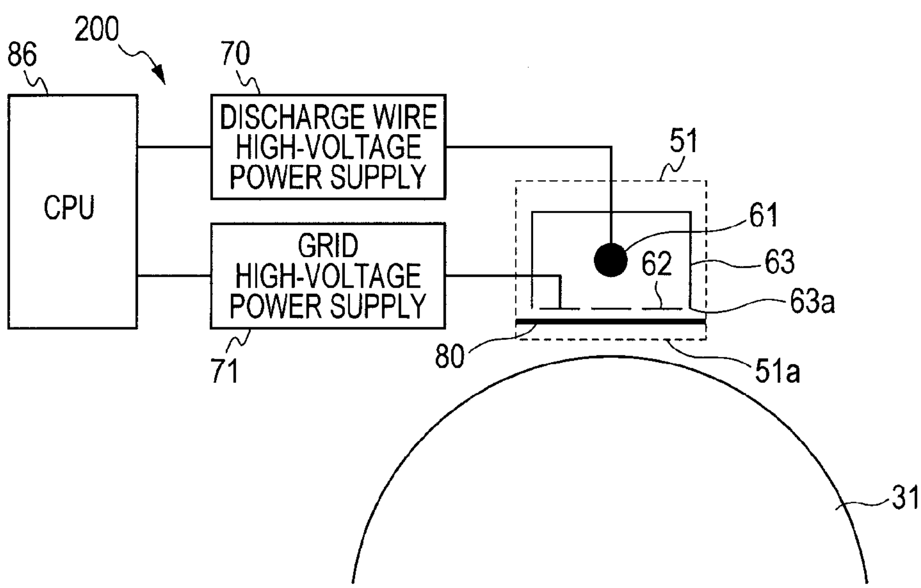

14
14a
12
21
11
28
25
23
22
26
100
24
29
50
27
30
10
32
33
13
44
43
31
38
42
39
35
34
36
40
37
101
41
15

FIG. 2

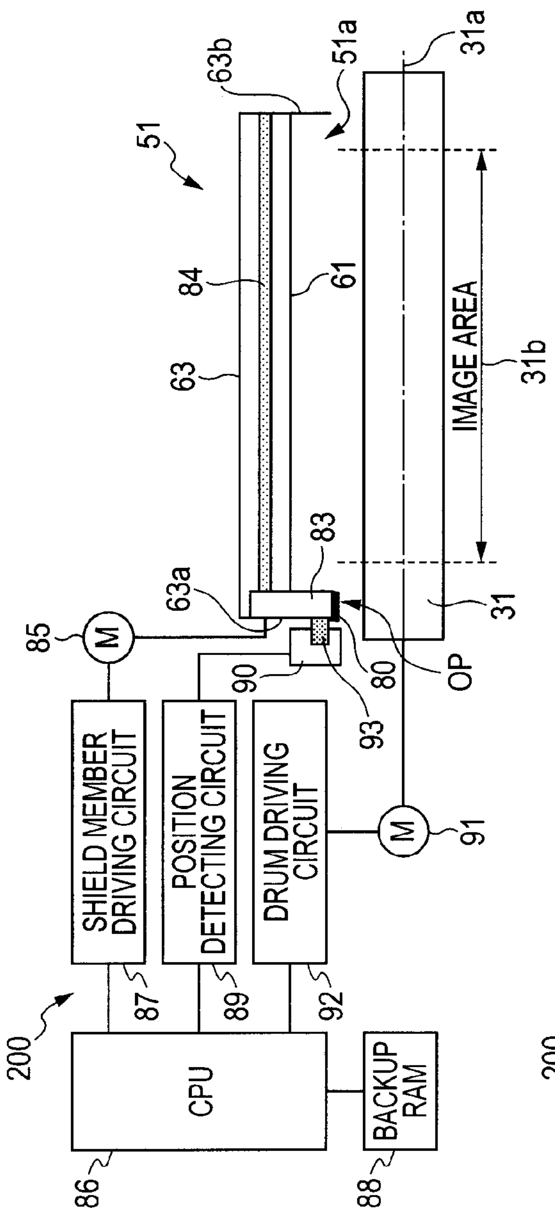


50
10
60
51
52
31
33
32
56
53
C
A
55
58
54
59
43

FIG. 3

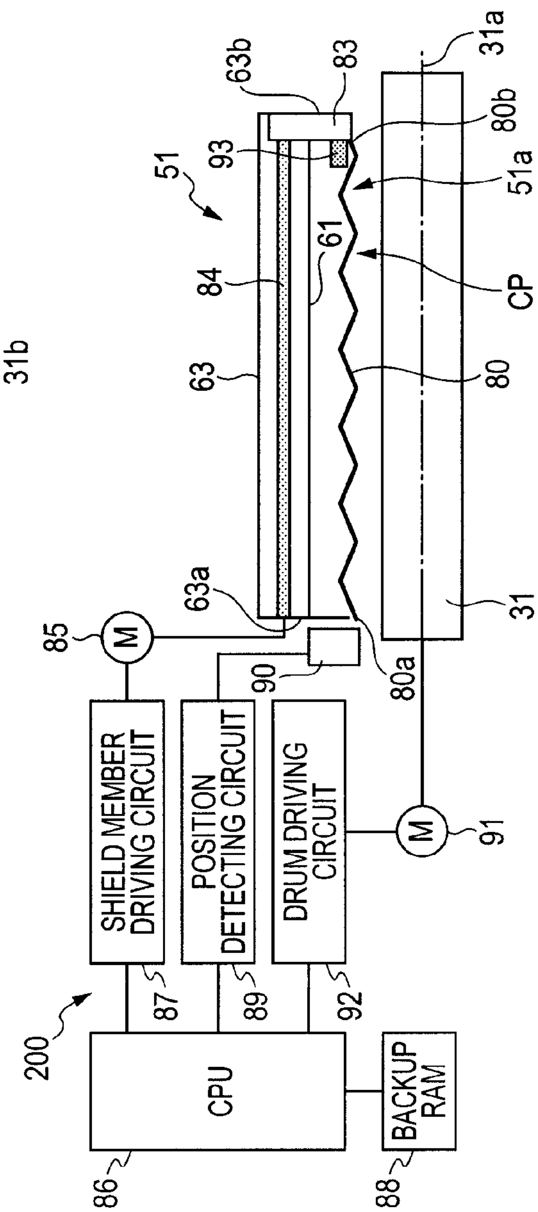


200
86
70
CPU
DISCHARGE WIRE HIGH-VOLTAGE POWER SUPPLY
GRID HIGH-VOLTAGE POWER SUPPLY
51
61
62
63
63a
80
51a
71
31



SHIELD MEMBER DRIVING CIRCUIT
POSITION DETECTING CIRCUIT
DRUM DRIVING CIRCUIT
CPU
BACKUP RAM
IMAGE AREA
M
200
86
87
88
89
92
85
90
91
93
80
OP
83
63a
63
84
61
63b
51
51a
31
31a
31b

FIG. 4A



SHIELD MEMBER DRIVING CIRCUIT
POSITION DETECTING CIRCUIT
DRUM DRIVING CIRCUIT
CPU
BACKUP RAM
M
200
86
87
88
89
92
85
90
91
80a
63a
63
84
61
80
CP
63b
93
83
80b
51
51a
31
31a

FIG. 4B

FIG. 4C

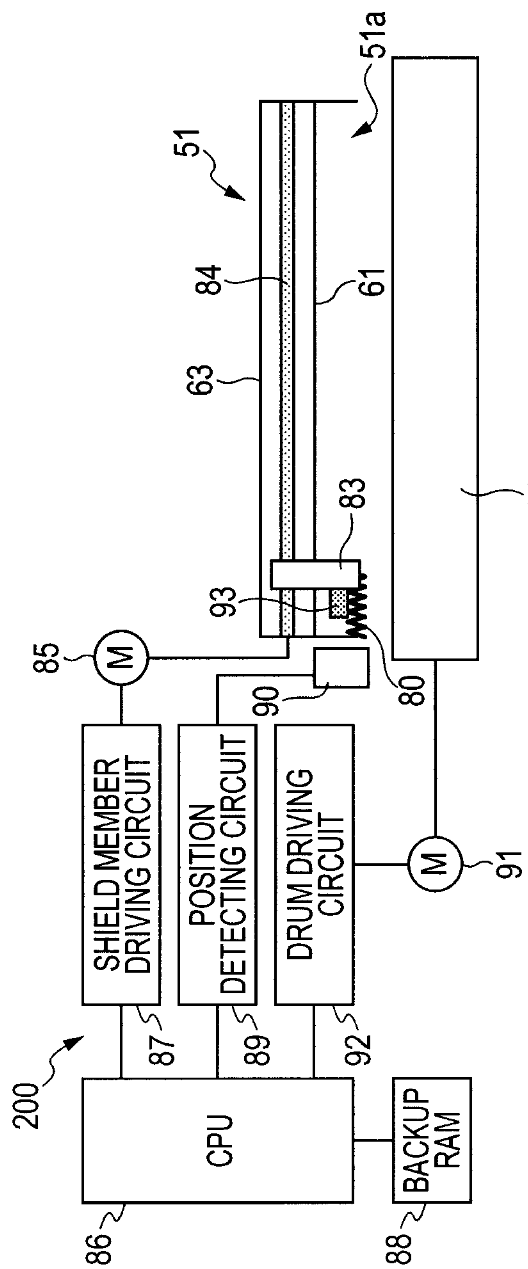

51a
51
84
61
63
83
31
93
80
85
M
90
SHIELD MEMBER DRIVING CIRCUIT
POSITION DETECTING CIRCUIT
DRUM DRIVING CIRCUIT
M
91
200
87
89
92
CPU
BACKUP RAM
86
88

FIG. 5

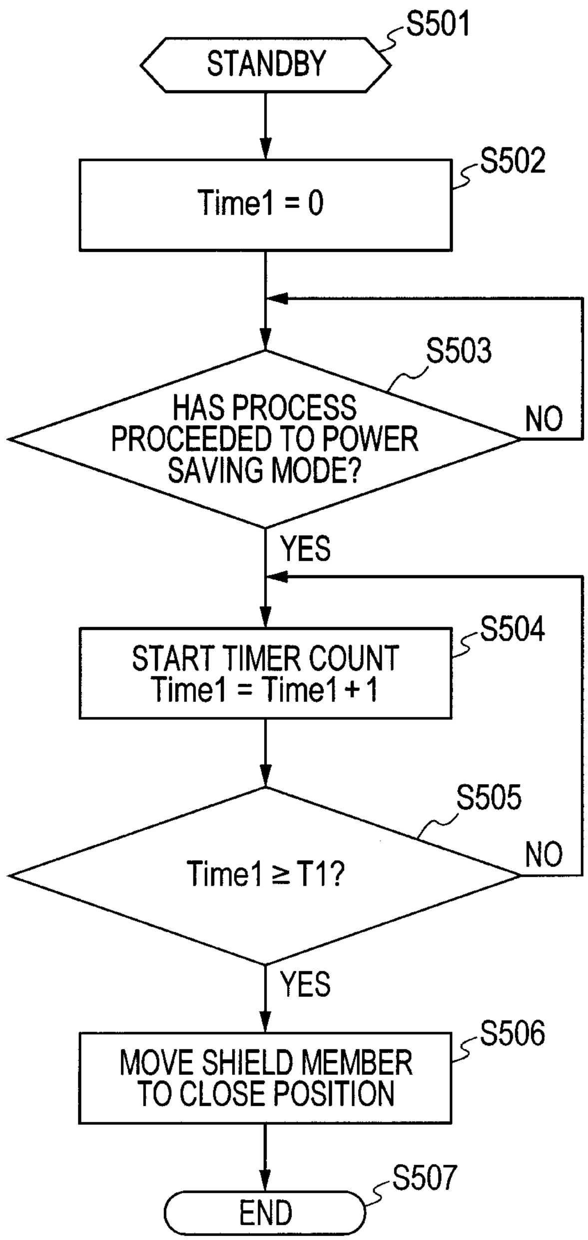

S501
STANDBY
S502
Time1 = 0
S503
HAS PROCESS PROCEEDED TO POWER SAVING MODE?
NO
YES
S504
START TIMER COUNT
Time1 = Time1 + 1
S505
Time1 ≥ T1?
NO
YES
S506
MOVE SHIELD MEMBER TO CLOSE POSITION
S507
END

FIG. 6

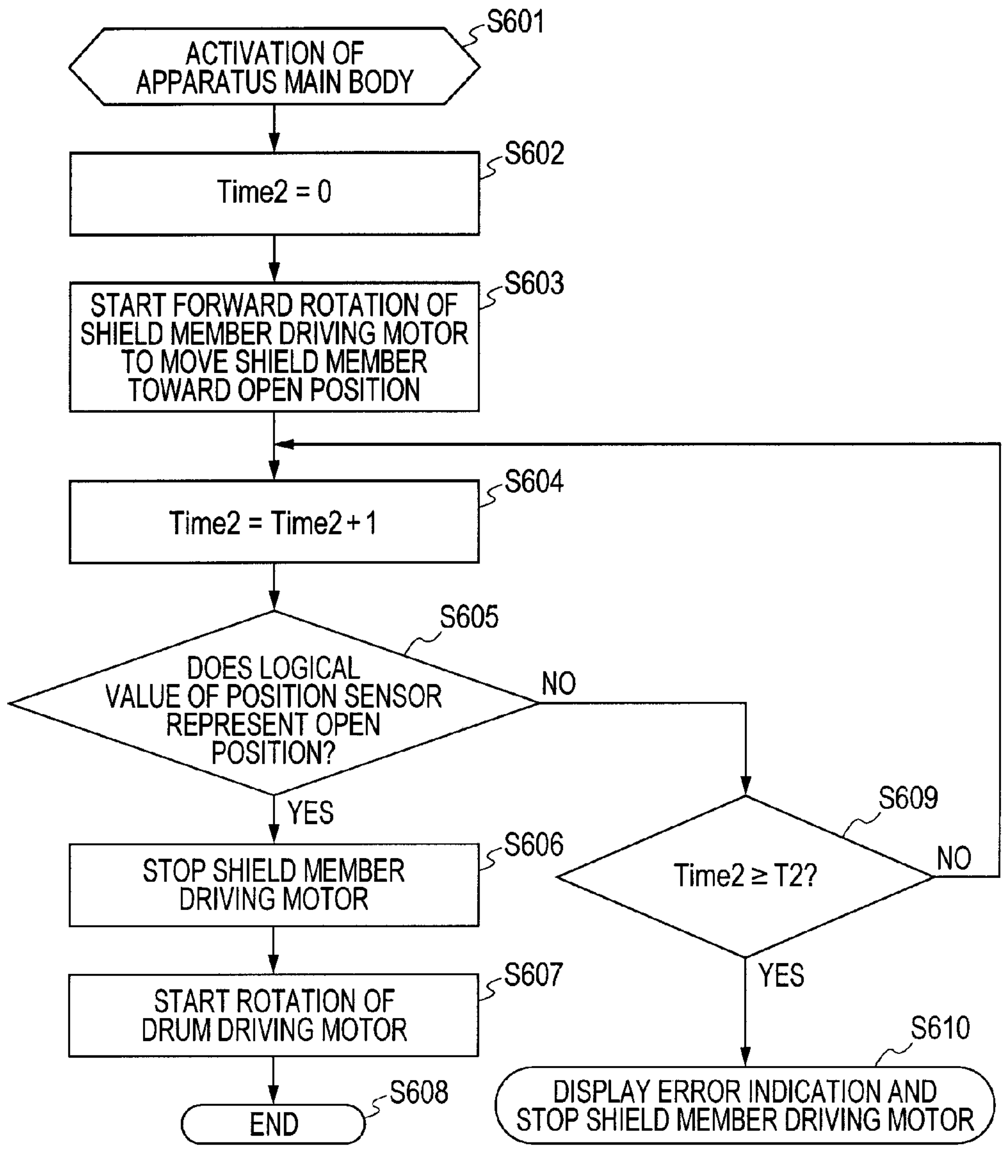

S601
ACTIVATION OF APPARATUS MAIN BODY
S602
Time2 = 0
S603
START FORWARD ROTATION OF SHIELD MEMBER DRIVING MOTOR TO MOVE SHIELD MEMBER TOWARD OPEN POSITION
S604
Time2 = Time2 + 1
S605
DOES LOGICAL VALUE OF POSITION SENSOR REPRESENT OPEN POSITION?
NO
YES
S606
STOP SHIELD MEMBER DRIVING MOTOR
S607
START ROTATION OF DRUM DRIVING MOTOR
S608
END
S609
Time2 ≥ T2?
NO
YES
S610
DISPLAY ERROR INDICATION AND STOP SHIELD MEMBER DRIVING MOTOR

FIG. 7

LOGICAL VALUE OF POSITION SENSOR	OPERATION	SEQUENCE
CLOSED POSITION	OPENING OPERATION	FLOWCHART OF FIGURE 6
OPEN POSITION	CLOSING OPERATION → OPENING OPERATION	FLOWCHART OF FIGURE 8

FIG. 8

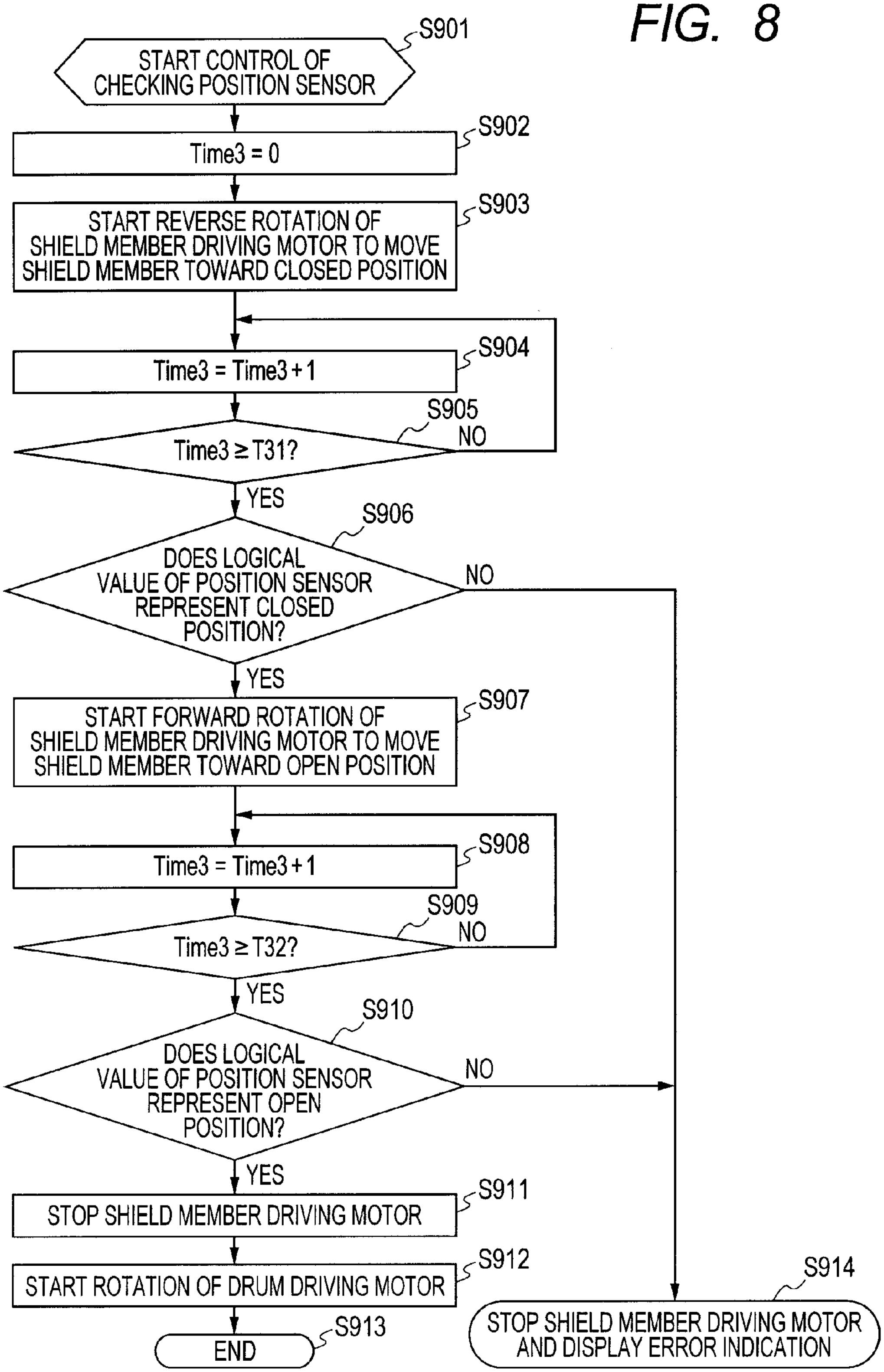

S901
START CONTROL OF CHECKING POSITION SENSOR
S902
Time3 = 0
S903
START REVERSE ROTATION OF SHIELD MEMBER DRIVING MOTOR TO MOVE SHIELD MEMBER TOWARD CLOSED POSITION
S904
Time3 = Time3 + 1
S905
Time3 ≥ T31?
NO
YES
S906
DOES LOGICAL VALUE OF POSITION SENSOR REPRESENT CLOSED POSITION?
NO
YES
S907
START FORWARD ROTATION OF SHIELD MEMBER DRIVING MOTOR TO MOVE SHIELD MEMBER TOWARD OPEN POSITION
S908
Time3 = Time3 + 1
S909
Time3 ≥ T32?
NO
YES
S910
DOES LOGICAL VALUE OF POSITION SENSOR REPRESENT OPEN POSITION?
NO
YES
S911
STOP SHIELD MEMBER DRIVING MOTOR
S912
START ROTATION OF DRUM DRIVING MOTOR
S913
END
S914
STOP SHIELD MEMBER DRIVING MOTOR AND DISPLAY ERROR INDICATION

FIG. 9

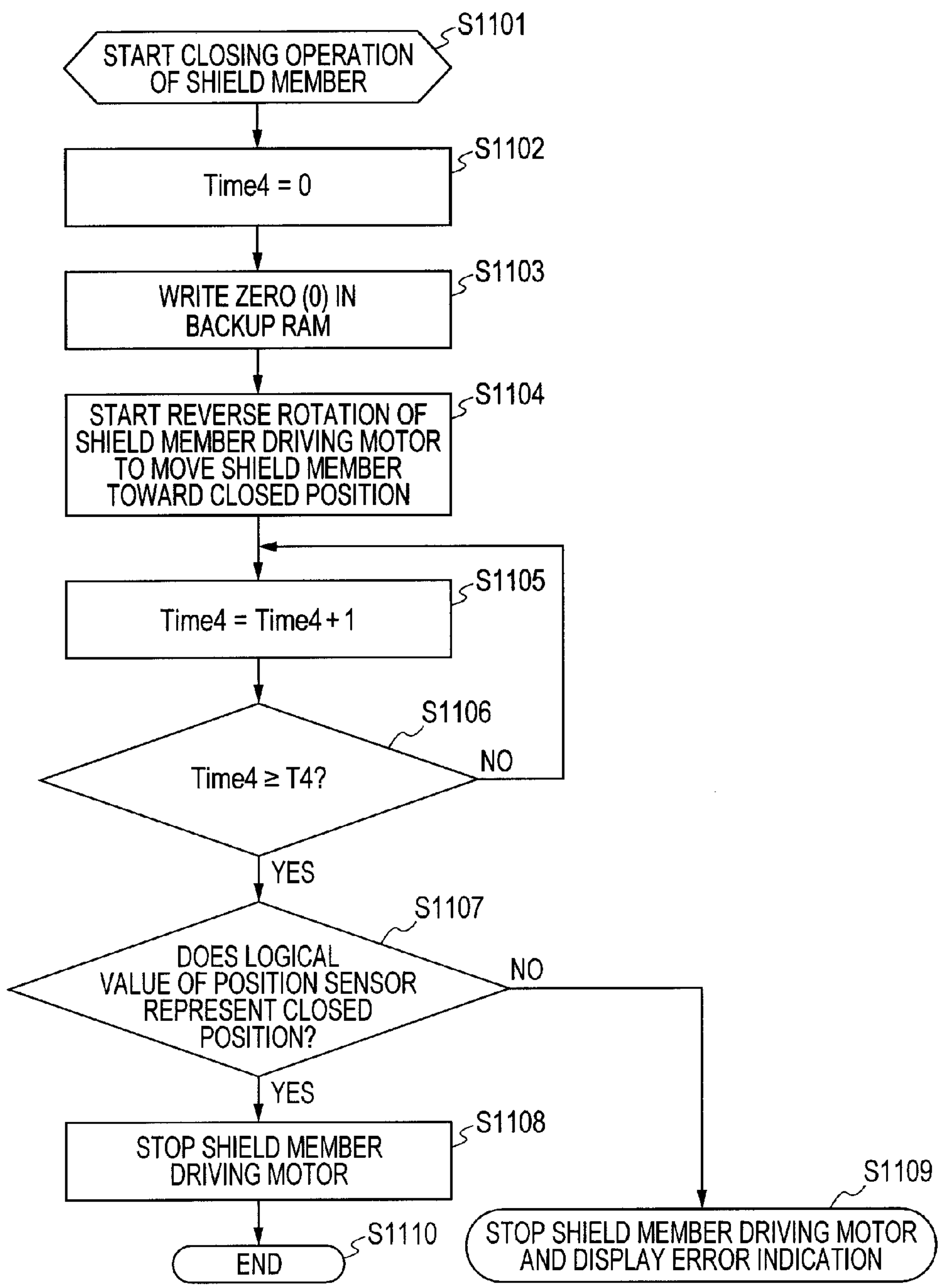

S1101
START CLOSING OPERATION OF SHIELD MEMBER
S1102
Time4 = 0
S1103
WRITE ZERO (0) IN BACKUP RAM
S1104
START REVERSE ROTATION OF SHIELD MEMBER DRIVING MOTOR TO MOVE SHIELD MEMBER TOWARD CLOSED POSITION
S1105
Time4 = Time4 + 1
S1106
Time4 ≥ T4?
NO
YES
S1107
DOES LOGICAL VALUE OF POSITION SENSOR REPRESENT CLOSED POSITION?
NO
YES
S1108
STOP SHIELD MEMBER DRIVING MOTOR
S1109
STOP SHIELD MEMBER DRIVING MOTOR AND DISPLAY ERROR INDICATION
S1110
END

FIG. 10

BACKUP VALUE	LOGICAL VALUE OF POSITION SENSOR	OPERATION	SEQUENCE
0	CLOSED POSITION	OPENING OPERATION	FLOWCHART OF FIGURE 11
1			
0	OPEN POSITION	CLOSING OPERATION → OPENING OPERATION	FLOWCHART OF FIGURE 12
1		OPERATION OF SHIELD MEMBER IS NOT PERFORMED	—

FIG. 11

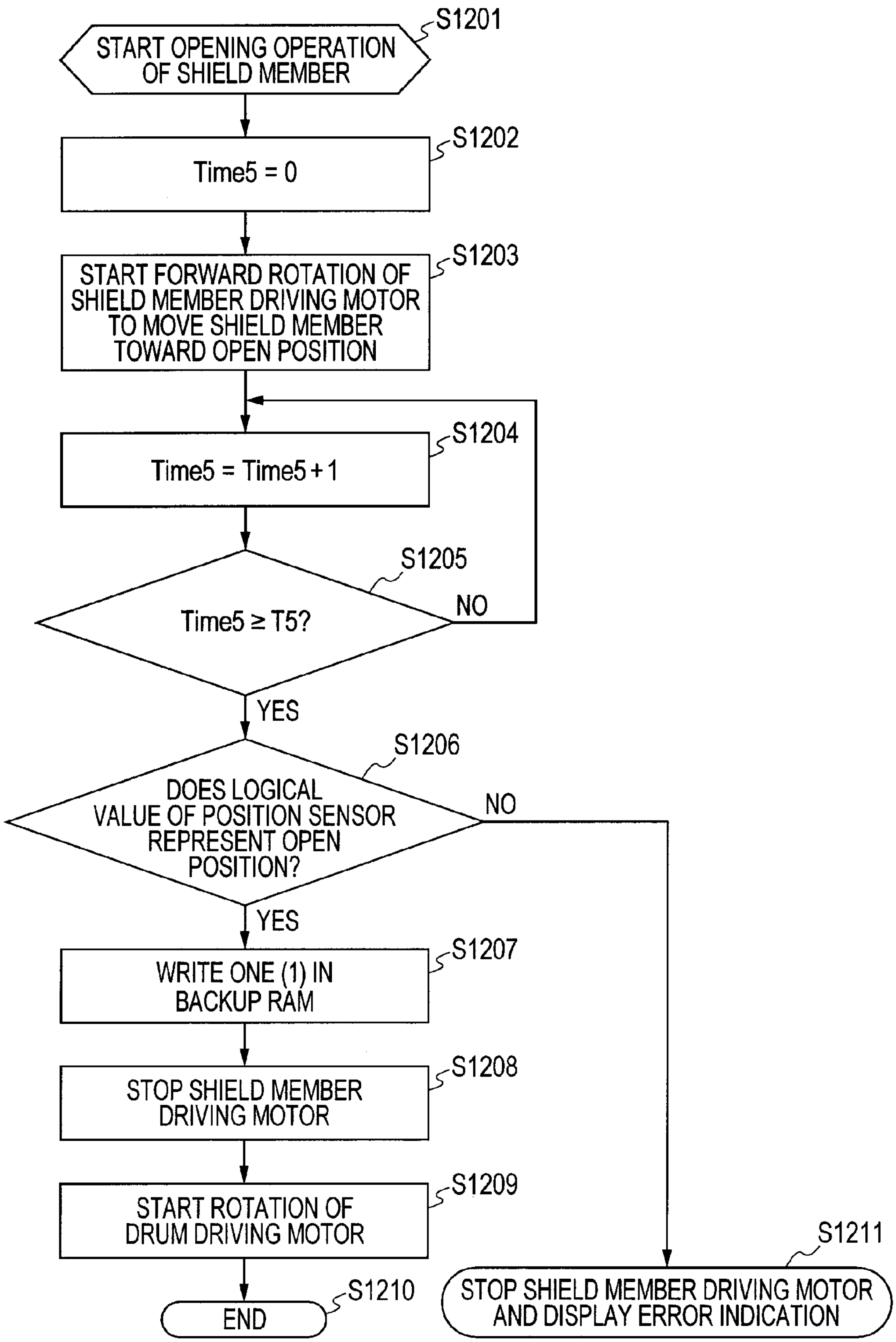

START OPENING OPERATION OF SHIELD MEMBER
S1201
Time5 = 0
S1202
START FORWARD ROTATION OF SHIELD MEMBER DRIVING MOTOR TO MOVE SHIELD MEMBER TOWARD OPEN POSITION
S1203
Time5 = Time5 + 1
S1204
Time5 ≥ T5?
S1205
NO
YES
DOES LOGICAL VALUE OF POSITION SENSOR REPRESENT OPEN POSITION?
S1206
NO
YES
WRITE ONE (1) IN BACKUP RAM
S1207
STOP SHIELD MEMBER DRIVING MOTOR
S1208
START ROTATION OF DRUM DRIVING MOTOR
S1209
END
S1210
STOP SHIELD MEMBER DRIVING MOTOR AND DISPLAY ERROR INDICATION
S1211

FIG. 12

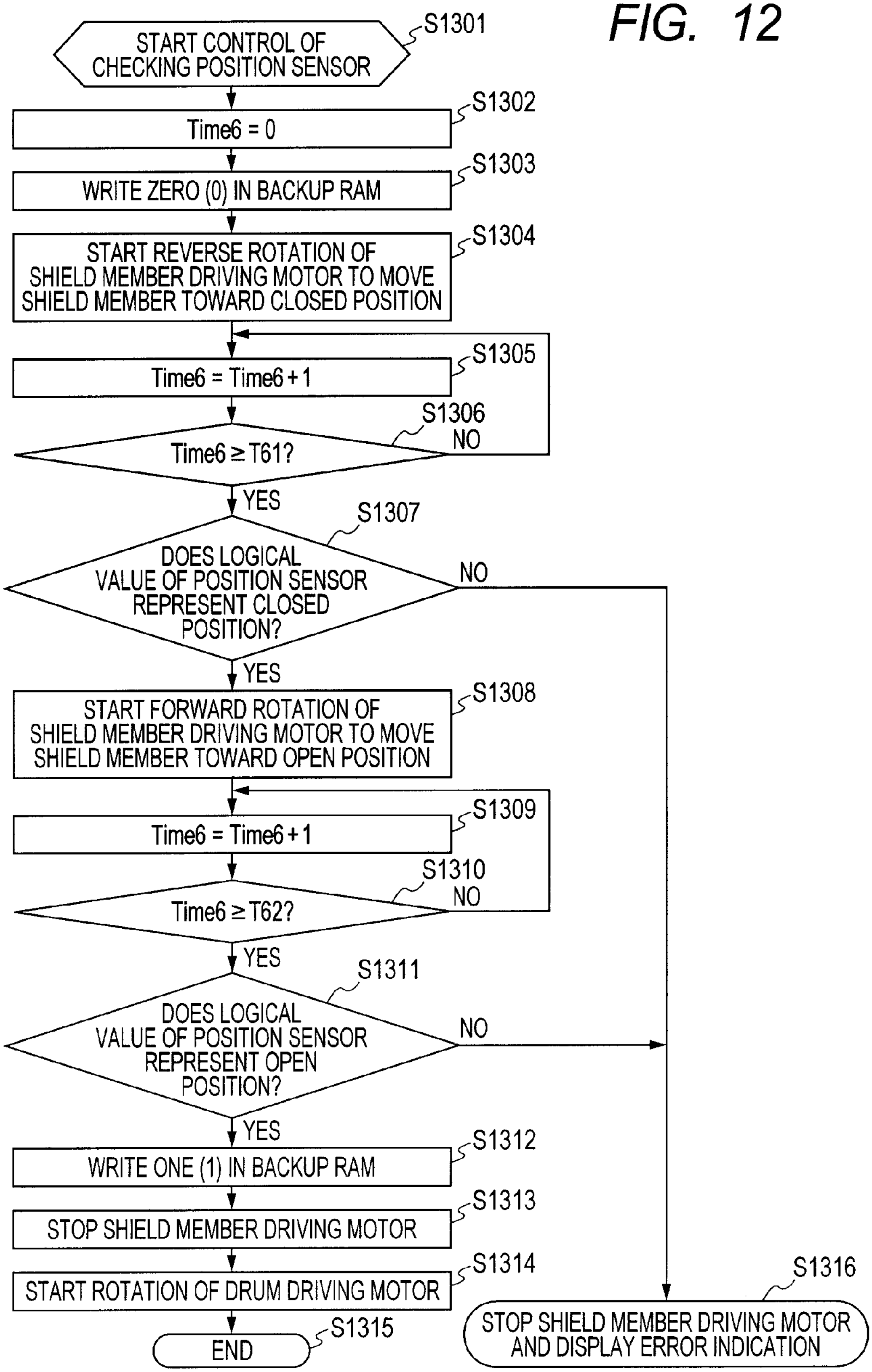

START CONTROL OF CHECKING POSITION SENSOR
S1301
Time6 = 0
S1302
WRITE ZERO (0) IN BACKUP RAM
S1303
START REVERSE ROTATION OF SHIELD MEMBER DRIVING MOTOR TO MOVE SHIELD MEMBER TOWARD CLOSED POSITION
S1304
Time6 = Time6 + 1
S1305
Time6 ≥ T61?
S1306
NO
YES
DOES LOGICAL VALUE OF POSITION SENSOR REPRESENT CLOSED POSITION?
S1307
NO
YES
START FORWARD ROTATION OF SHIELD MEMBER DRIVING MOTOR TO MOVE SHIELD MEMBER TOWARD OPEN POSITION
S1308
Time6 = Time6 + 1
S1309
Time6 ≥ T62?
S1310
NO
YES
DOES LOGICAL VALUE OF POSITION SENSOR REPRESENT OPEN POSITION?
S1311
NO
YES
WRITE ONE (1) IN BACKUP RAM
S1312
STOP SHIELD MEMBER DRIVING MOTOR
S1313
START ROTATION OF DRUM DRIVING MOTOR
S1314
END
S1315
STOP SHIELD MEMBER DRIVING MOTOR AND DISPLAY ERROR INDICATION
S1316

IMAGE FORMING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image forming apparatus including a charge device configured to charge a surface of a photosensitive member by discharging static electricity.

2. Description of the Related Art

An electrophotographic image forming apparatus is designed to form an image on a recording medium by an electrophotographic image forming process. Examples of the image forming apparatus include an electrophotographic copying machine, an electrophotographic printer (for example, a color laser beam printer and a color LED printer), a multifunction printer (MFP), a facsimile machine, and a word processor. The image forming apparatus represents a color image forming apparatus as well as an image forming apparatus for forming a monochrome image.

The image forming apparatus includes a photosensitive member. Examples of the photosensitive member include a drum-shaped or belt-shaped photosensitive member having a photoconductor as a photosensitive layer. The photosensitive layer is made of such a material as amorphous selenium, zinc oxide, cadmium sulfide, amorphous silicon, or an organic photoconductive material.

In an electrophotographic process of the image forming apparatus, first, the charge device charges the surface of the photosensitive member uniformly. Then, an exposure device emits light onto the uniformly-charged surface of the photosensitive member according to image information to form an electrostatic latent image on the surface of the photosensitive member. A developing device causes developer (toner) to adhere to the electrostatic latent image to obtain a toner image. A transfer device transfers the toner image from the photosensitive member to the recording medium. A fixing device fixes the toner image onto the recording medium. The recording medium having the image formed thereon is delivered to a delivery tray.

As one of the charge devices for the image forming apparatus, there is a corona charging device. The corona charging device charges the surface of the photosensitive member by corona discharge. The charge device includes a shield casing having an opening portion opposed to the surface of the photosensitive member, a discharge wire arranged inside the shield casing, and a high-voltage power supply for applying a high voltage to the discharge wire. The discharge wire is a metal wire having a diameter of about 50 to 100 microns (μm). The high-voltage power supply applies to the discharge wire a high voltage of about 5 to 10 kilovolts (kV) to cause corona discharge around the discharge wire. Through the corona discharge, air around the discharge wire is ionized to generate ions. The ions are supplied to the surface of the photosensitive member so that the surface of the photosensitive member is charged.

To the discharge wire, foreign substances such as silicon compounds may adhere, resulting in uneven charge. Therefore, the discharge wire needs to be cleaned or replaced on a periodic basis.

Further, the photosensitive member deteriorates due to ozone generated by corona discharge. The photosensitive member has, a characteristic that the surface thereof is likely to absorb moisture increasingly along with the deterioration process of the photosensitive member due to corona discharge. Ozone reacts with moisture in the air to generate an ozone product, which adheres to the surface of the photosensitive member that is likely to absorb moisture, The ozone product causes a drop in surface resistance of the photosensitive member to hinder the sufficient charge of the photosensitive member when the electrostatic latent image is formed, with the result that image deletion occurs. There is a technology for preventing the image deletion by constantly heating the photosensitive member by a heater to remove moisture from the surface of the photosensitive member (Japanese Utility Model Publication No. H01-34205). However, the ozone product is generated to a great extent during, tor example, nighttime in which the image forming apparatus is not in use, Therefore, the photosensitive member needs to be heated constantly by a heater, resulting in higher power consumption.

In view of the above, there is a technology for keeping an ozone product generated hear the discharge wire away from the photosensitive member by arranging a shield member between the photosensitive member and the charge device (Japanese Patent Application Laid-Open No. 2007-072212). Japanese Patent Application Laid-Open No. 2007-072212 discloses that the heater for warming the photosensitive member is turned of in a power saving mode and, at the same time, the shield member is moved so that the shield member photosensitive member forms the charge device. Because the heater can be turned off, the power consumption an be reduced.

In the corona charging device, the clearance between the charge device and the photosensitive member is set as small as about several hundred μm to 2 millimeters (mm). In this structure, the shield member having a thickness of about several dozen μm may be moved through such a small clearance. If the photosensitive member is rotated when the shield member is situated at a closed position at which the charge device is isolated by the shield member, however, the shield member may interfere with the photosensitive member due to wind pressure and vibration caused by the rotation of the photosensitive member, and the shield member may consequently damage the photosensitive member. The damage to the photosensitive member may cause an image defect. Further, the damage to the photosensitive member may cause leakage of the high voltage discharged from the charge device. The leakage of the high voltage may result in malfunction of the image forming apparatus.

SUMMARY OF THE INVENTION

In view of the above, it is an object of the present invention to prevent a shield member from interfering with a photosensitive member when the photosensitive member is driven.

In order to achieve the above-mentioned object, the present invention provides an image forming apparatus, which charges and exposes a surface of a photosensitive member to form an electrostatic latent image, and develops the electrostatic latent image to form a toner image on the photosensitive member, the image forming apparatus including: a photosensitive member driving unit configured to rotate the photosensitive member; a charge unit having an opening portion opposed to the surface of the photosensitive member, the charge unit configured to charge the surface of the photosensitive member; a shield member, which is movable between a closed position at which the shield member closes the opening portion of the charge unit and an open position at which the shield member opens the opening portion; a shield member driving unit configured to move the shield member between the closed position and the open position; and a control unit configured to control the photosensitive member driving unit so that the photosensitive member is rotated in a state in which the shield member is situated at the open position, and that the photosensitive member is prevented from being driven in a state in which the shield member is situated at the closed position.

Further, the present invention provides an image forming apparatus, which charges and exposes a surface of a photosensitive member to form an electrostatic latent image, and develops the electrostatic latent image to form a toner image on the photosensitive member, the image forming apparatus including: a photosensitive member driving unit configured to rotate the photosensitive member; a charge unit having an opening portion opposed to the surface of the photosensitive member, the charge unit configured to charge the surface of the photosensitive member; a shield member, which is movable between a closed position at which the opening portion of the charge unit is closed and an open position at which the opening portion is opened; a shield member driving unit configured to move the shield member between the closed position and the open position; and a control unit configured to control the shield member driving unit and the photosensitive member driving unit so that the photosensitive member is rotated after the shield member is moved to the open position.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view of an image forming apparatus according to a first embodiment of the present invention;

FIG. **2** is an enlarged sectional view of an image forming portion of the image forming apparatus according to the first embodiment;

FIG. **3** is a sectional view of a photosensitive drum and a charge device as viewed along an axial direction of the photosensitive drum according to the first embodiment;

FIGS. **4**A, **4**B, and **4**C are sectional views of the photosensitive drum and the charge device as viewed along a direction perpendicular to an axis of the photosensitive drum according to the first embodiment;

FIG. **5** is a flowchart illustrating a sequence performed in a power saving mode according to the first embodiment;

FIG. **6** is a flowchart illustrating a sequence to be performed when an apparatus main body is activated according to the first embodiment;

FIG. **7** is a table showing a switchover between sequences to be performed when the apparatus main body is activated according to a second embodiment of the present invention;

FIG. **8** is a flowchart illustrating a sequence of checking an operation of a position sensor according to the second embodiment;

FIG. **9** is a flowchart illustrating a sequence of a closing operation of a shield member according to a third embodiment of the present invention;

FIG. **10** is a table showing a switchover between sequences to be performed when the apparatus main body is activated according to the third embodiment;

FIG. **11** is a flowchart illustrating a sequence of an opening operation of the shield member according to the third embodiment; and

FIG. **12** is a flowchart illustrating a sequence of checking the operation of the position sensor according to the third embodiment.

DESCRIPTION OF THE EMBODIMENTS

Preferred embodiments of the present invention will now be described in detail in accordance with the accompanying drawings.

First Embodiment

(Image Forming Apparatus)

FIG. **1** is a sectional view of an image forming apparatus **100** according to a first embodiment of the present invention. An apparatus main body **101** of the image forming apparatus **100** includes an image forming portion **10** and an image reading portion **11**, which is arranged above the image forming portion **10**. On the apparatus main body **101**, an automatic document feeder **12** and a display portion (display unit) **14** are provided. The automatic document feeder **12** feeds a document to the image reading portion **11**. The image reading portion **11** reads an image on the document. Image information obtained through the reading is sent to the image forming portion **10**. The image forming portion **10** forms the image on a recording medium based on the image information obtained through the reading by the image reading portion **11** or image information sent from an external apparatus.

The display portion **14** includes an operation portion **14***a*. A user uses the operation portion **14***a* to set a copy mode or perform other operation. The display portion **14** may display various setting values such as a current job status and error status of the image forming apparatus **100**.

The apparatus main body **101** is provided with sheet containing portions **34**, **35**, **36**, and **37** configured to contain sheets as the recording media. The user may load the sheets into the sheet containing portions **34**, **35**, **36**, and **37** depending on sheet sizes of the sheets. A large-capacity sheet deck **15** is removably connected to the outside of the apparatus main body **101**. The sheets in the sheet containing portions **34**, **35**, **36**, and **37** and in the sheet deck **15** are transported to the image forming portion **10** by pairs of transport rollers **39**, **38**, **40**, **41**, and **42**, respectively, each driven by a motor (not shown).

The image reading portion **11** includes a light source **21**, which is movable in the lateral direction of FIG. **1**, mirrors **22**, **23**, and **24**, a lens **25**, and a CCD **26**. The light source **21** emits light onto a document placed on a document platen (not shown) of the image reading portion **11** to scan the document. The light from the light source **21** is reflected by the document. The reflected light is reflected by the mirrors **22**, **23**, and **24** and passes through the lens **25** to form an image on the CCD **26**. The CCD **26** converts the formed image into an electric signal. The electric signal is converted into digital image data by an image reading processing portion (not shown). The digital image data is subjected to image conversion involving scaling by the user operating the operation portion **14***a*, and is stored in an image memory (not shown) as image information.

The image forming portion **10** includes an exposure device (laser scanner unit) **50** above a photosensitive drum **31** serving as a photosensitive member. The exposure device **50** includes a semiconductor laser **28** configured to emit a laser beam, a rotary polygon mirror **27** configured to deflect the laser beam, an f-θ lens **29** configured to uniform the scanning speed of the laser beam, and a reflective mirror **30**. An image formation processing portion (not shown) retrieves the image information stored in the image memory (not shown), and modulates the pulse width of the laser beam from the semiconductor laser **28** according to the image information. The modulated laser beam illuminates the photosensitive drum **31** via the rotary polygon mirror **27**, the f-θ lens **29**, and the reflective mirror **30** to form a latent image on the surface of the photosensitive drum **31**.

(Image Forming Process)

FIG. **2** is an enlarged sectional view of the image forming portion **10** of the image forming apparatus **100**. The image forming portion **10** includes the photosensitive drum **31**. The photosensitive drum **31** has a surface of a photoconductive layer made of an organic photoconductor. The photosensitive drum **31** is rotated at a constant speed in a direction indicated by an arrow A during an image forming operation. For the image formation, first, a pre-exposing device (residual charge eliminator) **52** eliminates residual charges on the photosensitive drum **31** after the previous image formation. Then, a charge device (charge unit) **51** charges the surface of the photosensitive drum **31** uniformly. The exposure device **50** emits the laser beam modulated based according to the image information onto the photoconductive layer of the photosensitive drum **31** to form an electrostatic latent image on the surface of the photosensitive drum **31**. After that, a developing device **33** causes developer (hereinafter, referred to as toner) to adhere to the electrostatic latent image on the photosensitive drum **31** to visualize the electrostatic latent image as a developer image (hereinafter, referred to as a toner image). Meanwhile, a sheet **58** is transported from one of the sheet containing portions **34**, **35**, **36**, and **37** or the sheet deck **15** through a sheet transport path to the image forming portion **10**. The sheet **58** is transported to a transfer portion between the photosensitive drum **31** and a transfer charger **55** by registration rollers **44** in synchronization with the toner image. The transfer charger **55** charges the sheet **58** to transfer the toner image on the photosensitive drum **31** to the sheet **58**. After that, a separation charger **54** charges the sheet **58** so as to facilitate separation of the sheet **58** from the photosensitive drum **31**. The sheet **58** separated from the photosensitive drum **31** is conveyed by a conveyor belt **59** to a fixing nip between a fixing roller **32** and a pressure roller **43** of a fixing device **60**. The fixing roller **32** is rotated in a direction indicated by an arrow C. The fixing device **60** includes a thermistor **56** configured to detect temperature of the fixing roller **32**. The temperature of the fixing roller **32** is controlled based on a detection value from the thermistor **56**. In the fixing device **60**, the unfixed toner image on the sheet **58** is fused and fixed onto the sheet **58**. The sheet **58** having the toner image fixed thereonto is delivered to the outside of the apparatus main body **101** through a sheet delivery sensor (not shown). Meanwhile, toner remaining on the photosensitive drum **31**, which is not transferred to the sheet **58**, is scraped off by a drum cleaner **53**. To eliminate residual charges on the photosensitive drum **31**, the entire surface of the photosensitive drum **31** is exposed by the pre-exposing device **52**. As a result, the photosensitive drum **31** becomes ready for the next image formation.

(Charge Device)

FIG. **3** is a sectional view of the photosensitive drum **31** and the charge device **51** as viewed along an axial direction of the photosensitive drum **31**. The charge device **51** is a charge device of a non-contact charging type, which charges the surface of the photosensitive drum **31** by corona discharge. The charge device **51** extends along the axial direction of the photosensitive drum **31**, and is opposed to the surface of the photosensitive drum **31**. The charge device **51** includes a discharge wire **61**, a grid electrode **62**, a shield casing **63**, and a shield member **80**. The discharge wire **61** extends along the axial direction of the photosensitive drum **31**, and is arranged inside the shield casing **63**. The shield casing **63** is provided with an opening portion **63***a* that opens toward the photosensitive drum **31**. The grid electrode **62** is arranged between the discharge wire **61** and the photosensitive drum **31** near the opening portion **63***a* of the shield casing **63**. The grid electrode **62** is a plate member formed into a mesh. The shield member **80** is structured so as to isolate the photosensitive drum **31** from the grid electrode **62**. The shield member **80** may be situated at a closed position at which the shield member **80** closes an opening portion **51***a* of the charge device **51**, and may also be situated at an open position at which the shield member **80** opens the opening portion **51***a*. A control portion **200** includes a CPU (control device) **86** as a control unit, a discharge wire high-voltage power supply **70**, and a grid high-voltage power supply **71**. The grid electrode **62** is electrically connected to the grid high-voltage power supply **71**. The grid high-voltage power supply **71** applies a predetermined voltage to the grid electrode **62**. The discharge wire **61** is electrically connected to the discharge wire high-voltage power supply **70**. The discharge wire high-voltage power supply **70** and the grid high-voltage power supply **71** are controlled by the CPU **86**. The CPU **86** controls a potential of the grid electrode **62** and a current of the discharge wire **61**. The discharge wire high-voltage power supply **70** is controlled by the CPU **86** so as to cause a constant current to flow through the discharge wire **61**, and maintains corona discharge around the discharge wire **61**. Ions generated by corona discharge reach the photosensitive drum **31** via the grid electrode **62**. The amount of ions that are to reach the photosensitive drum **31** is controlled by the potential of the grid electrode **62**. The shield casing **63** is provided so as not to apply corona discharge to other portions than the photosensitive drum **31**. In order that the potential of the shield casing **63** does not increase to a predetermined voltage or more, the shield casing **63** is connected to a portion having the same potential as the grid electrode **62**, or alternatively, connected to a portion having a ground potential (GND) via a varistor. In the embodiment, the grid electrode **62** is connected to the grid high-voltage power supply **71** to have a predetermined voltage applied thereto. The grid electrode **62** may be connected to a portion of the apparatus main body **101** having the ground potential via the varistor so that the potential of the grid electrode **62** does not increase to a varistor voltage or more. The grid electrode **62** is arranged about several hundred μm to 1 mm apart from the surface of the photosensitive drum **31**. As the distance between the grid electrode **62** and the surface of the photosensitive drum **31** is larger, it is necessary to increase a value of the current flowing through the discharge wire **61**. In order to increase the value of the current flowing through the discharge wire **61**, it is necessary to increase the capacity of the discharge wire high-voltage power supply **70**. Therefore, it is preferred that the distance between the grid electrode **62** and the surface of the photosensitive drum **31** is as small as possible. An ozone product that may cause image deletion is generated in a portion between the discharge wire **61** and the photosensitive drum **31**. By providing the shield member **80**, the ozone product that may cause the image deletion is prevented from flowing from the discharge wire **61** toward the surface of the photosensitive drum **31**.

(Shield Member)

FIGS. **4**A, **4**B, and **4**C are sectional views of the photosensitive drum **31** and the charge device **51** as viewed along a direction perpendicular to an axis **31***a* of the photosensitive drum **31** according to the first embodiment. FIG. **4**A is a view illustrating an open position OP at which the opening portion **51***a* of the charge device **51** is opened by the shield member **80**. FIG. **4**B is a view illustrating a closed position CP at which the opening portion **51***a* of the charge device **51** is closed by the shield member **80**. The shield member **80** is a foldable, retractable bellows. One end portion **80***a* of the shield member **80** is fixed to one end portion **63***a* of the shield casing **63**. The other end portion **80***b* of the shield member **80** is fixed to a support plate **83**. The support plate **83** is threadingly engaged with a screw shaft **84**. The screw shaft **84** is connected to a shield member driving motor (shield member driving unit) **85** serving as a shield member driving device.

When the screw shaft **84** is rotated by the shield member driving motor **85**, the support plate **83** is moved in a direction along the axis **31***a* of the photosensitive drum **31** due to the threading engagement between the screw shaft **84** and the support plate **83**. When the support plate **83** is situated at the one end portion **63***a* of the shield casing **63** as illustrated in FIG. **4**A, the shield member **80** is situated at the open position OP at which the opening portion **51***a* of the charge device **51** is opened. The open position (a predetermined position) OP is a retracted position to which the shield member **80** is retracted so that the shield member **80** is not entangled with the photosensitive drum **31** when the photosensitive drum **31** is rotated. When the support plate **83** is situated at the other end portion **63***b* of the shield casing **63** as illustrated in FIG. **4**B, the shield member **80** is situated at the closed position CP at which the opening portion **51***a* of the charge device **51** is closed by the shield member **80**. When the shield member **80** is situated at the open position OP as illustrated in FIG. **4**A, the shield member **80** and the support plate **83** are retracted out of a range of an image area **31***b* of the photosensitive drum **31**. The control portion **200** includes the CPU (control device) **86**, a shield member driving circuit **87**, a backup RAM **88**, a position detecting circuit **89**, and a drum driving circuit **92**. The shield member driving motor **85** is connected to the shield member driving circuit **87**. The shield member driving circuit **87** is connected to the CPU **86**. The CPU **86** controls the shield member driving circuit **87** and thereby causes the shield member driving motor **85** to perform forward rotation and reverse rotation. The forward rotation of the shield member driving motor **85** moves the shield member **80** from the closed position to the open position OP. The reverse rotation of the shield member driving motor **85** moves the shield member **80** from the open position to the closed position CP. In other words, a switchover between the forward rotation and the reverse rotation of the shield member driving motor **85** enables the movement of the shield member **80** from the closed position CP to the open position OP and from the open position OP to the closed position CP.

A position sensor (photo-interrupter) **90** serving as a position detecting unit configured to detect the open position OP of the shield member **80** is arranged in the vicinity of the one end portion **63***a* of the shield casing **63**. A light-blocking plate **93** for blocking light of the position sensor **90** is provided on the support plate **83**. When the light-blocking plate **93** blocks light of the position sensor **90**, the support plate **83** is situated at the one end portion **63***a* of the shield casing **63**, and the shield member **80** is situated at the open position OP. The position sensor **90** is connected to the position detecting circuit **89**. The position detecting circuit **89** is connected to the CPU **86**. A signal from the position sensor **90** is transmitted to the CPU **86** via the position detecting circuit **89**. Based on the signal from the position sensor **90**, the CPU **86** determines whether or not the shield member is situated at the open position (the predetermined position) OP. When the signal (logical value) of the position sensor **90** represents the open position OP, the shield member **80** is situated at the open position OP, and hence the opening portion **51***a* of the charge device **51** is fully opened. Specifically, when the signal (logical value) of the position sensor **90** represents the open position OP, the shield member **80** is retracted to a position at which the shield member **80** is free from a fear of being entangled with the photosensitive drum **31** even when the photosensitive drum **31** is rotated. When the signal (logical value) of the position sensor **90** does not represent the open position OP, on the other hand, the light of the position sensor **90** is not blocked by the light-blocking plate **93**. The state in which the signal (logical value) of the position sensor **90** does not represent the open position OP is hereinafter referred to as a state in which the signal (hereinafter, referred to as logical value) of the position sensor **90** represents the closed position CP. Specifically, the logical value of the position sensor **90** represents the closed position when the opening portion **51***a* of the charge device **51** is fully closed by the shield member **80** as illustrated in FIG. **4**B, and also when only part of the opening portion **51***a* of the charge device **51** is closed by the shield member **80** as illustrated in FIG. **4**C. When the logical value of the position sensor represents the closed position, the light of the position sensor **90** is not blocked by the light-blocking plate **93**.

The photosensitive drum **31** is connected to a drum driving motor (photosensitive member driving unit) **91** serving as a photosensitive member driving device. The drum driving motor **91** is electrically connected to the drum driving circuit **92**. The drum driving circuit **92** is connected to the CPU **86**. The CPU **86** rotates the drum driving motor **91** via the drum driving circuit **92**, to thereby drive, that is, rotate the photosensitive drum **31**.

(Opening/Closing Operation of Shield Member)

A general sequence of opening/closing the shield member **80** will be described. In this embodiment, the shield member **80** is moved from the open position OP to the closed position CP when a predetermined time has elapsed after the apparatus main body **101** enters a power saving mode, and when the power of the apparatus main body **101** is shut down. In other cases than the above, the shield member **80** is generally situated at the open position OP. This is because the need to move the shield member **80** is eliminated when a print job is started. If the shield member **80** is situated at the closed position CP during the operation of the apparatus main body **101**, there arises a need to move the shield member **80** to the open position OP so as to charge the photosensitive drum **31** when the print job is started. The start of printing is accordingly delayed by a period of time necessary to move the shield member **80** to the open position OP. Further, the amount of the ozone product generated increases as the amount of moisture absorption of the photosensitive drum **31** increases. During the operation of the apparatus main body **101**, the photosensitive drum **31** is heated by heat from the fixing device **60**, and hence the amount of the ozone product generated is small. In the power saving mode or after the shutdown, on the other hand, the temperature inside the apparatus main body **101** drops, and hence the ozone product is likely to be generated. Further, in the power saving mode, the apparatus main body **101** may recover to a normal mode through the user's operation immediately after the apparatus main body **101** enters the power saving mode. When the shield member **80** is opened/closed in this case, the shield member driving motor **85** is driven frequently, which accelerates deterioration of the shield member driving motor **85**. Therefore, in this embodiment, the shield member is moved from the open position OP to the closed position CP when several hours (a predetermined time) have elapsed after the apparatus main body **101** enters the power saving mode. After the lapse of several hours, the temperature inside the apparatus main body **101** drops to a certain extent.

(In Power Saving Mode)

FIG. **5** is a flowchart illustrating a sequence performed in the power saving mode according to the first embodiment. Referring to the flowchart illustrated in FIG. **5**, a control operation of the shield member **80** performed by the CPU **86** in the power saving mode will be described. When the apparatus main body **101** is in a standby state (S**501**), the CPU **86** initializes a timer Time**1** to 0 (Time**1**=0), the timer Time**1** being used for starting the closing operation of the shield member **80** (S**502**). When the apparatus main body **101** enters the power saving mode (YES in S**503**), the CPU **86** starts counting the timer Time**1** (S**504**). The CPU **86** determines whether or not the timer Time**1** is equal to or larger than a predetermined value T**1** (S**505**). The predetermined value T**1** is preset to several hours, by which the temperature inside the apparatus main body **101** is expected to be a certain predetermined temperature or lower. When the timer Time**1** is equal to or larger than the predetermined value T**1** (YES in S**505**), the CPU **86** causes the shield member driving motor **85** to move the shield member **80** to the closed position CP (S**506**), and proceeds to the subsequent operation (S**507**).

When the apparatus main body **101** recovers from the power saving mode to the normal mode before the timer Time**1** becomes equal to or larger than the predetermined value T**1**, the CPU **86** does not move the shield member **80** to the closed position CP, and hence the shield member **80** remains at the open position OP.

(When Apparatus Main Body is Shut Down)

When the power of the apparatus main body **101** is shut down, the shield member **80** is moved from the open position OP to the closed position CP.

In the power saving mode, however, power supply to the control portion **200** of the apparatus main body **101** may be stopped partially. For example, power supply to the shield member driving circuit **87** illustrated in FIG. **4**A may be stopped. In this case, when the power (main switch) of the apparatus main body **101** is turned off and AC power supply to the control portion **200** is stopped after the apparatus main body **101** enters the power saving mode, the apparatus main body **101** is stopped without entering the standby state. As in this case, the shield member **80** is not sometimes moved to the closed position CP when the power of the apparatus main body **101** is shut down.

Further, the discharge wire **61** of the charge device **51** is periodically replaced while the apparatus main body is shut down. A service engineer periodically maintains the discharge wire **61** to prevent an image defect that may occur when foreign substances adhere to the discharge wire **61**. During the maintenance, the service engineer may sometimes move the shield member **80**. In this case, whether the shield member **80** is situated at the closed position CP or at the open position OP cannot be determined accurately next time the apparatus main body **101** is activated. If the photosensitive drum **31** rotates when the shield member **80** is situated at a position other than the open position OP, the shield member **80** may be entangled with the photosensitive drum **31** so that the photosensitive drum **31** may be damaged. Particularly when the shield member **80** is situated within the image area **31***b*, rotation of the photosensitive drum **31** needs to be prevented.

(When Apparatus Main Body is Activated)

FIG. **6** is a flowchart illustrating a sequence to be performed when the apparatus main body is activated according to the first embodiment. Referring to the flowchart of FIG. **6**, control performed by the CPU **86** when the apparatus main body **101** is activated will be described. When the power of the apparatus main body is turned on and the apparatus main body **101** starts to be activated (S**601**), the CPU **86** initializes a timer Time**2** to 0 (Time**2**=0), the timer Time**2** being used for counting time to be taken during the opening operation of the shield member **80** (S**602**). The CPU **86** starts forward rotation of the shield member driving motor **85** to move the shield member **80** toward the open position OP (S**603**). The CPU **86** starts counting the timer Time**2** (S**604**). The CPU **86** determines whether or not the logical value of the position sensor **90** represents the open position (S**605**). When it is determined that the logical value of the position sensor **90** represents the open position (YES in S**605**), the CPU **86** stops the shield member driving motor **85** (S**606**). At this time, because it may be determined that the shield member **80** is outside the range of the image area **31***b*, the CPU **86** starts rotation of the drum driving motor **91** (S**607**), and proceeds to the subsequent sequence (S**608**). According to this embodiment, even if the shield member **80** is moved to a position other than the open position OP during the maintenance, the CPU **86** can move the shield member **80** to the open position OP when the apparatus main body **101** is activated. When it is determined that the shield member **80** is situated at the open position OP, the CPU **86** causes the drum driving motor **91** to drive the photosensitive drum **31**, resulting in a low probability that the shield member **80** is wound around the rotating photosensitive drum **31**.

By the way, in a case where the position sensor fails or the light-blocking plate **93** fixed to the support plate **83** is broken and therefore no signal is acquired from the position sensor **90**, the CPU **86** cannot determine in Step S**605** whether or not the logical value of the position sensor **90** represents the open position. Therefore, there is provided a time-out quit feature (time-up function) in the timer Time**2**. When it is determined in Step S**605** that the logical value of the position sensor **90** does not represent the open position (NO in Step S**605**), the CPU **86** determines whether or not the count of the timer Time**2** represents that a predetermined time T**2** has elapsed (S**609**). The predetermined time T**2** is a sufficient period of time it takes to move the shield member **80** to the open position OP or a period of time longer than that period of time. When the count of the timer Time**2** represents that the predetermined time T**2** has not elapsed (NO in S**609**), the CPU **86** returns to **5604**. When the count of the timer Time**2** represents that the predetermined time T**2** has elapsed (YES in S**609**), the above-mentioned failure may have occurred. Therefore, the CPU **86** displays an error indication on the display portion **14** and stops the shield member driving motor **85** (S**610**).

As described above, when it is determined that the shield member **80** is situated at the open position (predetermined position) OP, the CPU **86** causes the drum driving motor **91** to drive the photosensitive drum **31**. When it is determined that the shield member **80** is situated at the closed position CP, the CPU **86** controls the drum driving motor **91** so as not to drive the photosensitive drum **31**. This embodiment ensures reliable detection that the shield member **80** is situated at the open position OP, which accordingly prevents the shield member **80** from being entangled with the photosensitive drum **31**. The damage to the photosensitive drum **31** can be reduced, which may be caused when the shield member **80** falling within the range of the image area **31***b* is entangled with the photosensitive drum **31**. The image defect and the malfunction of the apparatus main body due to the damage to the photosensitive drum **31** can be suppressed.

In this embodiment, the CPU **86** determines whether or not the shield member **80** is situated at the open position OP based on the logical value of the position sensor **90** every time the timer Time**2** is counted. However, the present invention is not limited thereto. The CPU **86** may determine whether or not the shield member **80** is situated at the open position OP based on the logical value of the position sensor **90** when the driving time of the shield member driving motor **85** has reached to a predetermined time. Alternatively, the CPU **86** may determine that the shield member **80** is situated at the open position OP when, instead of using the logical value of the position sensor **90**, the driving time of the shield member driving motor **85** has reached to a predetermined time. When it is determined that the shield member **80** is situated at the open position OP, the CPU **86** causes the drum driving motor **91** to drive the photosensitive drum **31**.

In this embodiment, the shield member **80** is a bellows, but the shield member **80** may be a thin plate member. When the shield member **80** is a thin plate member, it is preferred that the shield member **80** is slidably held by the charge device **51**. Further, the movement of the shield member **80** is not limited to the movement in the direction along the axis **31***a* of the photosensitive drum **31**, and the shield member **80** may be structured so as to move in a direction perpendicular to the axis **31***a*, to thereby open/close the opening portion **51***a* of the charge device **51**.

Second Embodiment

Hereinbelow, an image forming apparatus according to a second embodiment of the present invention will be described. The image forming apparatus, a charge device, a shield member, and a control portion of the second embodiment have substantially the same structure as those of the first embodiment, respectively. In the second embodiment, the same components as those of the first embodiment are denoted by the same reference symbols, and description thereof is therefore omitted.

There is a fear that, due to an abnormality such as a failure in the position sensor **90**, the CPU **86** determines that the shield member **80** is situated at the open position OP even though the shield member **80** is situated at the closed position CP. If the photosensitive drum **31** is rotated in this case, the shield member **80** situated at the closed position CP may be entangled with the photosensitive drum **31** to damage the photosensitive drum **31**. Therefore, the following operation is performed in the second embodiment so as to detect the abnormality such as the failure in the position sensor **90**.

FIG. **7** is a table showing a switchover between sequences to be performed when the apparatus main body is activated according to the second embodiment. When the apparatus main body **101** is activated, the CPU **86** determines whether the logical value of the position sensor **90** represents the open position or the closed position. If the logical value of the position sensor **90** represents the closed position, as shown in the table of FIG. **7**, the shield member **80** is moved to the open position OP according to the sequence of FIG. **6**. If the logical value of the position sensor **90** represents the open position when the apparatus main body **101** is activated, the position sensor **90** may be in failure. Therefore, as shown in the table of FIG. **7**, the following operation is performed according to a sequence of FIG. **8** so as to check whether or not the operation of the position sensor **90** is normal. The shield member **80** is temporarily moved toward the closed position CP. The shield member **80** may be moved until the shield member **80** fully covers the opening portion **51***a* of the charge device **51**, but it takes a long period of time to perform such an operation. Therefore, as illustrated in FIG. **4**C, the shield member **80** may be driven to a position at which the light-blocking plate **93** of the support plate **83** comes out of the position sensor **90**.

(Sequence of Checking Operation of Position Sensor)

FIG. **8** is a flowchart of the sequence of checking the operation of the position sensor **90**. When the apparatus main body **101** is activated, the CPU **86** determines whether the logical value of the position sensor **90** represents the open position or the closed position. When the logical value of the position sensor **90** represents the open position, the CPU **86** starts control of checking the operation of the position sensor **90** (S**901**). The CPU **86** initializes a timer Time**3** to 0 (Time**3**=0) (S**902**). The CPU starts reverse rotation of the shield member driving motor **85** to move the shield member **80** toward the closed position CP (S**903**). The CPU **86** starts counting the timer Time**3** (S**904**), and determines whether or not the count of the timer Time**3** represents that a predetermined time T**31** has elapsed (S**905**). The predetermined time T**31** may be a period of time that is necessary until the shield member **80** fully covers the opening portion **51***a* of the charge device **51** as illustrated in FIG. **4**B, but may be a period of time that is necessary until the light-blocking plate **93** of the support plate **83** comes out of the position sensor **90** as illustrated in FIG. **4**C. When the count of the timer Time**3** represents that the predetermined time T**31** has elapsed (YES in S**905**), the CPU **86** determines whether or not the logical value of the position sensor **90** represents the closed position (S**906**). When the logical value of the position sensor **90** represents the closed position (YES in S**906**), the CPU **86** can recognize that the shield member driving motor **85** is normally driven and the position sensor **90** normally operates. The CPU **86** starts forward rotation of the shield member driving motor **85** to move the shield member **80** toward the open position OP (S**907**). When the logical value of the position sensor **90** represents the open position (NO in S**906**), on the other hand, the CPU **86** determines that the position sensor **90**, the shield member driving motor **85**, or the shield member driving circuit **87** is in failure. The CPU **86** stops the shield member driving motor **85** and displays on the display portion **14** an error indicating the abnormal state (S**914**). After the CPU **86** causes the shield member driving motor **85** to start movement of the shield member **80** toward the open position OP in Step S**907**, the CPU **86** starts counting the timer Time**3** again (S**908**). The CPU **86** determines whether or not the count of the timer Time**3** represents that a predetermined time T**32** has elapsed (S**909**). The predetermined time T**32** is set to a period of time required for the shield member **80** to arrive at the open position OP or a period of time longer than that period of time. When the count of the timer Time**3** represents that the predetermined time T**32** has elapsed (YES in S**909**), the CPU **86** determines whether or not the logical value of the position sensor **90** represents the open position (S**910**). When the logical value of the position sensor **90** represents the closed position (NO in S**910**), in the same manner as in the case of "NO" determination in S**906**, the CPU **86** stops the shield member driving motor **85** and displays on the display portion **14** an error indicating the abnormal state (S**914**). When the logical value of the position sensor **90** represents the open position (YES in S**910**), on the other hand, the CPU **86** can recognize that the shield member driving motor **85** is normally driven and the position sensor **90** normally operates. The CPU **86** stops the shield member driving motor **85** (S**911**). Because the shield member **80** can be recognized as being situated normally at the open position OP, the CPU **86** starts rotation of the drum driving motor **91** (S**912**), and proceeds to the subsequent sequence (S**913**).

In the second embodiment, the CPU **86** rotates the shield member driving motor **85** for the predetermined time (T**31** or T**32**) so as to check whether or not the position sensor **90** normally operates. Alternatively, the CPU **86** may rotate the shield member driving motor **85** while monitoring the logical value of the position sensor **90**. When the logical value of the position sensor **90** changes, the CPU **86** may change the rotation direction of the shield member driving motor **85** or stop the rotation. That is, the CPU **86** performs the reverse rotation of the shield member driving motor **85** to start movement of the shield member **80** toward the closed position CP, and monitors the logical value of the position sensor **90**. When the logical value of the position sensor **90** changes from the open position to the closed position, the CPU **86** performs the forward rotation of the shield member driving motor **85** to start movement of the shield member **80** toward the open position OP, and monitors the logical value of the position sensor **90**. When the logical value of the position sensor **90** changes from the closed position to the open position, the CPU **86** stops the rotation of the shield member driving motor **85**, and then causes the drum driving motor **91** to rotate the photosensitive drum **31**. Alternatively, the driving time of the shield member driving motor **85** may be preset. When the set time has elapsed, the CPU **86** may determine that the shield member **80** is situated at the open position OP, and may cause the drum driving motor **91** to rotate the photosensitive drum **31**.

Third Embodiment

Hereinbelow, an image forming apparatus according to a third embodiment of the present invention will be described. The image forming apparatus, a charge device, a shield member, and a control portion of the third embodiment have substantially the same structure as those of the first embodiment, respectively. In the third embodiment, the same components as those of the first embodiment are denoted by the same reference symbols, and description thereof is therefore omitted.

In the second embodiment, if the logical value of the position sensor **90** represents the open position when the apparatus main body **101** is activated, the CPU **86** performs the control of checking the operation of the position sensor **90** (FIG. **8**). The control of checking the operation of the position sensor **90** involves the closing operation and the opening operation of the shield member **80**, and hence the activation time of the apparatus main body **101** may increase. In order to prevent such an increase in activation time, the control of checking the operation of the position sensor **90** may be omitted in a case where it is highly possible that the shield member **80** is actually opened. Therefore, in the third embodiment, the CPU **86** stores a history of the operation of the shield member **80** in a storage device, and based on the stored history, determines whether or not it is highly possible that the shield member **80** is actually opened. That is, in the third embodiment, if the logical value of the position sensor **90** represents the open position and it is determined based on the stored history that it is highly possible that the shield member **80** is actually situated at the open position OP when the apparatus main body **101** is activated, the control of checking the operation of the position sensor **90** is omitted.

As illustrated in FIG. **4**A, the backup RAM **88** serving as the storage device (storage unit) is connected to the CPU **86**. The backup RAM **88** holds a value representing whether the CPU **86** has previously moved the shield member **80** toward the open position OP or the closed position CP. Because a battery circuit (not shown) is provided, the backup RAM **88** can hold the value even if the apparatus main body **101** is shut down. The CPU **86** sets a value of a flag of the backup RAM **88** to 0, and then, via the shield member driving circuit **87**, causes the shield member driving motor **85** to move the shield member **80** toward the closed position CP. The CPU **86** causes the shield member driving motor **85** to move the shield member **80** toward the open position OP, and thereafter, when the CPU **86** receives from the position sensor **90** a signal (logical value) representing the open position, the CPU **86** sets the value of the flag of the backup RAM **88** to 1. The fact that the value of the flag of the backup RAM **88** is 0 means that the previous operation of the shield member driving motor **85** is an operation of moving the shield member **80** toward the closed position CP. The fact that the value of the flag of the backup RAM **88** is 1 means that the previous operation of the shield member driving motor **85** is an operation of moving the shield member **80** toward the open position OP.

In the third embodiment, the CPU **86** holds the history of the movement of the shield member **80** in the backup RAM **88**. If the maintenance of the charge device **51** is performed while the apparatus main body **101** does not operate, however, the position of the shield member **80** may sometimes be changed in a state in which the CPU **86** cannot recognize the movement of the shield member **80**. Therefore, after the apparatus main body **101** is activated, the CPU **86** switches the operation mode based on the value of the flag of the backup RAM **88** and the logical value of the position sensor **90**, to thereby reduce the risk that the shield member **80** is wound around the photosensitive drum **31**.

(Sequence of Closing Operation of Shield Member)

First, rewriting of the value of the flag of the backup RAM **88** in the sequence of the closing operation of the shield member **80** will be described. FIG. **9** is a flowchart illustrating the sequence of the closing operation of the shield member according to the third embodiment. After the apparatus main body **101** enters the power saving mode or when the power of the apparatus main body **101** is turned off, the CPU **86** starts the sequence of the closing operation of the shield member **80** (S**1101**). When the CPU **86** starts the sequence of the closing operation of the shield member **80**, the CPU **86** initializes a timer Time**4** for counting a closing time to 0 (Time**4**=0) (S**1102**). The CPU **86** rewrites the value of the flag of the backup RAM **88** to 0 (S**1103**). After that, the CPU **86** starts reverse rotation of the shield member driving motor **85** to move the shield member **80** toward the closed position CP (S**1104**). The CPU **86** starts counting the timer Time**4** (S**1105**), and determines whether or not the count of the timer Time**4** represents that a predetermined time T**4** has elapsed (S**1106**). The predetermined time T**4** is a period of time required for the shield member **80** to fully cover the opening portion **51***a* of the charge device **51** as illustrated in FIG. **4**B. When the count of the timer Time**4** represents that the predetermined time T**4** has elapsed (YES in S**1106**), the CPU **86** determines whether or not the logical value of the position sensor **90** represents the closed position (S**1107**). When the logical value of the position sensor **90** represents the closed position (YES in S**1107**), the CPU **86** can determine that the shield member driving motor **85** is normally driven and the shield member **80** is situated normally at the closed position CP. The CPU **86** stops the shield member driving motor **85** (S**1108**), and ends the sequence of the closing operation (S**1110**). When the logical value of the position sensor **90** represents the open position in Step S**1107** (NO in S**1107**), on the other hand, the CPU **86** determines that the position sensor **90**, the shield member driving motor **85**, or the shield member driving circuit **87** is in failure. The CPU **86** stops the shield member driving motor **85** and displays on the display portion **14** an error indicating the abnormal state (S**1109**).

(When Apparatus Main Body is Activated)

FIG. **10** is a table showing a switchover between sequences to be performed when the apparatus main body is activated according to the third embodiment. When the apparatus main body **101** is activated, the CPU **86** switches between sequences based on the value of the flag of the backup RAM **88** and the logical value of the position sensor **90**.

<Case Where Logical Value of Position Sensor Represents Closed Position>

If the logical value of the position sensor **90** represents the closed position when the apparatus main body **101** is activated, as shown in the table of FIG. **10**, irrespective of whether the value of the flag of the backup RAM **88** is 0 or 1, the CPU **86** starts a sequence illustrated in a flowchart of FIG. **11**. When the logical value of the position sensor **90** represents the closed position, the previous operation of the shield member driving motor **85** is normally an operation of moving the shield member **80** toward the closed position CP, and hence the value of the flag of the backup RAM **88** is 0. When the value of the backup RAM is 1, however, the previous operation of the shield member driving motor **85** is an operation of moving the shield member **80** toward the open position OP, and hence the value of the flag of the backup RAM does not match with the logical value of the position sensor **90**. This condition indicates that, due to maintenance or the like, the shield member **80** may be closed while the apparatus main body **101** does not operate.

FIG. **11** is a flowchart illustrating a sequence of the opening operation of the shield member according to the third embodiment. If the logical value of the position sensor **90** represents the closed position when the apparatus main body **101** is activated, irrespective of whether the value of the flag of the backup RAM **88** is 0 or 1, the CPU starts the sequence of the opening operation of the shield member **80** (S**1201**). When the CPU **86** starts the sequence of the opening operation of the shield member **80**, the CPU **86** initializes a timer Time**5** for counting an opening time to 0 (Time**5**=0) (S**1202**). The CPU **86** starts forward rotation of the shield member driving motor **85** to move the shield member **80** toward the open position OP (S**1203**). The CPU **86** starts counting the timer Time**5** (S**1204**), and determines whether or not the count of the timer Time**5** represents that a predetermined time T**5** has elapsed (S**1205**). The predetermined time T**5** is a period of time required for the shield member **80** to move from the closed position CP (FIG. **4**B), at which the shield member **80** fully covers the opening portion **51***a* of the charge device **51**, to the open position OP (FIG. **4**A), at which the shield member **80** fully opens the opening portion **51***a* or a period of time longer than that period of time. When the count of the timer Time**5** represents that the predetermined time T**5** has elapsed (YES in S**1205**), the CPU **86** determines whether or not the logical value of the position sensor **90** represents the open position (S**1206**). When the logical value of the position sensor **90** represents the open position (YES in S**1206**), the CPU **86** can recognize that the shield member driving motor **85** is normally driven and the shield member **80** is situated normally at the open position OP. The CPU **86** rewrites the value of the flag of the backup RAM **88** to 1 (S**1207**). Then, the CPU **86** stops the shield member driving motor **85** (S**1208**). The CPU **86** starts rotation of the drum driving motor **91** (S**1209**), and proceeds to the subsequent sequence (S**1210**). When the logical value of the position sensor **90** represents the closed position in Step S**1206** (NO in S**1206**), on the other hand, the CPU **86** determines that the position sensor **90**, the shield member driving motor **85**, or the shield member driving circuit **87** is in failure. The CPU **86** stops the shield member driving motor **85** and displays on the display portion **14** an error indicating the abnormal state (S**1211**).

<Case Where Logical Value of Position Sensor Represents Open Position and Value of Flag of Backup RAM is 0>

If the logical value of the position sensor **90** represents the open position and the value of the flag of the backup RAM **88** is 0 when the apparatus main body **101** is activated, as shown in the table of FIG. **10**, the CPU **86** starts a sequence illustrated in a flowchart of FIG. **12**. When the logical value of the position sensor **90** represents the open position, the previous operation of the shield member driving motor **85** is normally an operation of moving the shield member **80** toward the open position OP, and hence the value of the flag of the backup RAM **88** is 1. When the value of the flag of the backup RAM **88** is 0, however, the previous operation of the shield member driving motor **85** is an operation of moving the shield member toward the closed position CP, and hence the value of the flag of the backup RAM does not match with the logical value of the position sensor **90**. This condition indicates that, due to maintenance or the like, the shield member **80** may be opened while the apparatus main body **101** does not operate.

FIG. **12** is a flowchart illustrating a sequence of checking the operation of the position sensor **90** according to the third embodiment. If the logical value of the position sensor **90** represents the open position and the value of the flag of the backup RAM **88** is 0 when the apparatus main body **101** is activated, the CPU **86** starts the sequence of checking the operation of the position sensor (S**1301**). When the CPU **86** starts the sequence of checking the operation of the position sensor **90**, the CPU **86** initializes a timer Time**6** to 0 (Time**6**=0) (S**1302**). The CPU **86** rewrites the value of the flag of the backup RAM **88** to 0 (S**1303**). After that, the CPU **86** starts reverse rotation of the shield member driving motor **85** to move the shield member **80** toward the closed position CP (S**1304**). The CPU **86** starts counting the timer Time**6** (S**1305**), and determines whether or not the count of the timer Time**6** represents that a predetermined time T**61** has elapsed (S**1306**). The predetermined time T**61** may be a period of time required for the shield member **80** to fully cover the opening portion **51***a* of the charge device **51** as illustrated in FIG. **4**B, but may be a period of time required for the light-blocking plate **93** of the support plate **83** to come out of the position sensor **90** as illustrated in FIG. **4**C. When the count of the timer Time**6** represents that the predetermined time T**61** has elapsed (YES in S**1306**), the CPU determines whether or not the logical value of the position sensor **90** represents the closed position (S**1307**). When the logical value of the position sensor **90** represents the closed position (YES in S**1307**), the CPU **86** can recognize that the shield member driving motor **85** is normally driven and the position sensor **90** normally operates. Thus, the CPU **86** starts forward rotation of the shield member driving motor **85** to move the shield member **80** toward the open position OP (S**1308**). When the logical value of the position sensor **90** represents the open position in Step S**1307** (NO in S**1307**), on the other hand, the CPU **86** can recognize that the position sensor **90**, the shield member driving motor **85**, or the shield member driving circuit **87** is in failure. Thus, the CPU **86** stops the shield member driving motor **85** and displays on the display portion **14** an error indicating the abnormal state (S**1316**). After the CPU **86** causes the shield member driving motor **85** to start movement of the shield member **80** toward the open position OP in Step S**1308**, the CPU **86** starts counting the timer Time**6** again (S**1309**). The CPU **86** determines whether or not the count of the timer Time**6** represents that a predetermined time T**62** has elapsed (S**1310**). The predetermined time T**62** is set to a period of time required for the shield member **80** to arrive at the open position OP or a period of time longer than that period of time. When the count of the timer Time**6** represents that the predetermined time T**62** has elapsed (YES in S**1310**), the CPU **86** determines whether or not the logical value of the position sensor **90** represents the open position (S**1311**). When the logical value of the position sensor **90** represents the closed position (NO in S**1311**), in the same manner as in the case of "NO" determination in Step S**1307**, the CPU **86** stops the shield member driving motor **85** and displays on the display portion **14** an error indicating the abnormal state (S**1316**). When the logical value of the position sensor **90** represents the open position (YES in S**1311**), on the other hand, the CPU **86** can recognize that the shield member driving motor **85** is normally driven and the position sensor **90** normally operates. The CPU **86** rewrites the value of the flag of the backup RAM **88** to 1 (S**1312**). The CPU **86** stops the shield member driving motor **85** (S**1313**). Because the shield member **80** can be recognized as being situated normally at the open position OP, the CPU **86** starts rotation of the drum driving motor **91** (S**1314**), and proceeds to the subsequent sequence (S**1315**).

In the third embodiment, the CPU **86** drives the shield member driving motor **85** for the predetermined time (T**61** or T**62**) so as to check whether or not the position sensor **90** normally operates. Alternatively, the CPU **86** may rotate the shield member driving motor **85** while monitoring the logical value of the position sensor **90**. When the logical value of the position sensor **90** changes, the CPU **86** may change the rotation direction of the shield member driving motor **85** or stop the rotation. That is, the CPU **86** performs the reverse rotation of the shield member driving motor **85** to start movement of the shield member **80** toward the closed position CP, and monitors the logical value of the position sensor **90**. When the logical value of the position sensor **90** changes from the open position to the closed position, the CPU **86** performs the forward rotation of the shield member driving motor **85** to start movement of the shield member **80** toward the open position OP, and monitors the logical value of the position sensor **90**. When the logical value of the position sensor **90** changes from the closed position to the open position, the CPU **86** rewrites the value of the flag of the backup RAM **88** to 1. The CPU **86** stops the rotation of the shield member driving motor **85**, and then causes the drum driving motor **91** to rotate the photosensitive drum **31**. Alternatively, the CPU **86** may preset the driving time of the shield member driving motor **85**. When the set time has elapsed, the CPU **86** determines that the shield member **80** is situated at the open position OP, and rewrites the value of the flag of the backup RAM **88** to 1. The CPU **86** may stop the rotation of the shield member driving motor **85**, and then cause the drum driving motor **91** to rotate the photosensitive drum **31**.

<Case Where Logical Value of Position Sensor Represents Open Position and Value of Flag of Backup RAM is 1>

If the logical value of the position sensor **90** represents the open position and the value of the flag of the backup RAM **88** is 1 when the apparatus main body **101** is activated, as shown in the table of FIG. **10**, the CPU **86** does not perform the operation of the shield member **80**. Under this condition, after the apparatus main body **101** is activated, the CPU **86** can quickly start the rotation of the photosensitive drum **31** via the drum driving motor **91** without performing the operation of the shield member **80**. As a result, the activation time of the apparatus main body **101** can be shortened. Under the condition that the logical value represents the open position and the value of the flag is **1**, the shield member **80** is situated at the open position OP last time the power of the apparatus main body **101** is stopped, and after that, the shield member **80** is not moved to the closed position CP while the apparatus main body **101** does not operate. As for the reason why the shield member **80** is not moved to the closed position CP last time the power of the apparatus main body **101** is turned off, it is conceivable that the power of the apparatus main body **101** is stopped in the event of a power outage or the like and hence the normal shutdown sequence cannot be performed.

In the above-mentioned embodiments, when the apparatus main body **101** is activated, the CPU **86** selects the operation sequence of the shield member **80** according to the table of FIG. **7** or FIG. **10** to operate the shield member **80**, but the present invention is not limited thereto. The CPU **86** may select the operation sequence to operate the shield member **80** according to the selected sequence when the charge device **51** is mounted on the apparatus main body **101** as well as when the apparatus main body **101** is activated. Alternatively, the CPU **86** may perform the above-mentioned sequence after a door (opening/closing member) of the apparatus main body **101** is opened and closed or when the apparatus main body **101** recovers from the power saving mode. The door of the apparatus main body **101** may be, for example, a door that is opened and closed at the time of maintenance of the charge device, or a door that is opened and closed at the time of loading sheets onto the sheet containing portions. The door of the apparatus main body **101** may be a door that allows access to the inside of the apparatus main body **101** for clearing a paper jam, a door that is opened and closed at the time of replacing a process cartridge, or a door (e.g., door **13**) that is opened and closed at the time of maintenance of the conveyor belt or the fixing device.

The above-mentioned embodiments are directed to the image forming apparatus that employs the photosensitive drum as the photosensitive member, but the present invention is not limited to the photosensitive drum, and is also applicable to an image forming apparatus that employs a photosensitive belt as the photosensitive member.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all modifications, equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2010-081587, filed Mar. 31, 2010, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An image forming apparatus, comprising:

a rotatable photosensitive member;

a corona charging device having an opening portion opposed to the photosensitive member and configured to charge the photosensitive member;

a toner image forming portion configured to form a toner image on the photosensitive member charged by the corona charging device;

a sheet-shaped shield member provided on the corona charging device and configured to open and close the opening portion;

a moving portion having a drive source configured to generate a driving force by a signal input to the drive source, the moving portion configured to move the shield member between a closed position at which the shield member closes the opening portion and an open position at which the shield member opens the opening portion by the driving force of the drive source;

a detecting portion configured to detect a state in which the shield member is in the open position;

a switch configured to activate the image forming apparatus by an operator's manipulation; and

a control portion configured to control the photosensitive member to allow the photosensitive member to rotate when the detecting portion detects the state in which the shield member is in the open position and to prevent the photosensitive member from rotating when the detecting portion does not detect the state in which the shield member is in the open position, wherein

the control portion operates in a mode for operating the moving portion to move the shield member in a direction for closing the opening portion in a case where the detecting portion does not detect the state in which the shield member is in the open position when the image forming apparatus is turned off by previous manipulation of the switch and where the detecting portion detects the state in which the shield member is in the open position when the image forming apparatus is activated by a manipulation of the switch subsequent to the previous manipulation, and

the control portion operates the moving portion to move the shield member in a direction for opening the opening portion when the detecting portion becomes unable to detect the state in which the shield member is in the open position within a predetermined period in which the moving portion is being moved in the direction for closing the opening portion in the mode, and thereafter the control portion allows the photosensitive member to rotate when the detecting portion detects the state in which the shield member is in the open position.

2. An image forming apparatus according to claim **1**, further comprising a display portion configured to display information,

wherein when the detecting portion detects the state in which the shield member is in the open position throughout the predetermined period in the mode, the control portion displays an error indication on the display portion without allowing the photosensitive member to rotate.

3. An image forming apparatus according to claim **1**, wherein the control portion allows the photosensitive member to rotate without executing the mode in a case where the detecting portion detects the state in which the shield member is in the open position when the image forming apparatus is turned off by the previous manipulation of the switch and where the detecting portion detects the state in which the shield member is in the open position when the image forming apparatus is activated by the manipulation of the switch subsequent to the previous manipulation.

4. An image forming apparatus according to claim **1**, wherein the control portion operates the moving portion to move the shield member in the direction for opening the opening portion without executing the mode in a case where the detecting portion does not detect the state in which the shield member is in the open position when the image forming apparatus is turned off by the previous manipulation of the switch and where the detecting portion does not detect the state in which the shield member is in the open position when the image forming apparatus is activated by the manipulation of the switch subsequent to the previous manipulation, and thereafter the control portion allows the photosensitive member to rotate when the detecting portion detects the state in which the shield member is in the open position.

5. An image forming apparatus, comprising:

a rotatable photosensitive member;

a corona charging device having an opening portion opposed to the photosensitive member and configured to charge the photosensitive member;

a toner image forming portion configured to form a toner image on the photosensitive member charged by the corona charging device;

an openable and closable door, wherein the corona charging device is detachably mounted by an operator to a main body of the image forming apparatus in a state in which the door is opened;

a sheet-shaped shield member provided on the corona charging device and configured to open and close the opening portion;

a moving portion having a drive source configured to generate a driving force by a signal input to the drive source, the moving portion configured to move the shield member between a closed position at which the shield member closes the opening portion and an open position at which the shield member opens the opening portion by the driving force of the drive source;

a detecting portion configured to detect a state in which the shield member is in the open position;

a switch configured to activate the image forming apparatus by the operator's manipulation; and

a control portion configured to control the photosensitive member to allow the photosensitive member to rotate when the detecting portion detects the state in which the shield member is in the open position and to prevent the photosensitive member from rotating when the detecting portion does not detect the state in which the shield member is in the open position, wherein

the control portion operates in a mode for operating the moving portion to move the shield member in a direction for closing the opening portion in a case where the detecting portion does not detect the state in which the shield member is in the open position when an opening operation for opening the door is performed by the operator in an ON state of the switch and where the detecting portion detects the state in which the shield member is in the open position when a closing operation for closing the door is performed by the operator subsequent to the opening operation in the ON state of the switch, and

the control portion operates the moving portion to move the shield member in a direction for opening the opening portion when the detecting portion becomes unable to detect the state in which the shield member is in the open position within a predetermined period in which the moving portion is being moved in the direction for closing the opening portion in the mode, and thereafter the control portion allows the photosensitive member to rotate when the detecting portion detects the state in which shield member is in the open position.

6. An image forming apparatus according to claim **5**, further comprising a display portion configured to display information,

wherein when the detecting portion detects the state in which the shield member is in the open position throughout the predetermined period in the mode, the control portion displays an error indication on the display portion without allowing the photosensitive member to rotate.

7. An image forming apparatus according to claim **5**, wherein the control portion allows the photosensitive member to rotate without executing the mode in a case where the state in which the detecting portion detects the shield member is in the open position when the opening operation is performed by the operator in the ON state of the switch and where the detecting portion detects the state in which the shield member is in the open position when the closing operation is performed by the operator subsequently to the opening operation in the ON state of the switch.

8. An image forming apparatus according to claim **5**, wherein the control portion operates the moving portion to move the shield member in the direction for opening the opening portion without executing the mode in a case where the detecting portion does not detect the state in which the shield member is in the open position when the opening operation is performed by the operator in the ON state of the switch and where the detecting portion does not detect the state in which the shield member is in the open position when the closing operation is performed by the operator subsequently to the opening operation in the ON state of the switch, and thereafter the control portion allows the photosensitive member to rotate when the detecting portion detects the state in which the shield member is in the open position.

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